Junior Division — SHORT PROBLEMS

1. What Does This Program Do? — Looping

When the following program is run, what is the final value of A?

```
10 A = 0
20 FOR J = 1 TO 10 STEP 3
30   FOR K = J TO 10 STEP 4
40     A = A + J * K
50   NEXT K
60 NEXT J
```

2. Computer Number Systems

Solve for X:

$$X_8 = 3247_8 + 6435_8$$

3. Computer Number Systems

Which number is the largest? Express your answer as a letter, **a**, **b**, **c**, etc. If there's a tie, list all.

(**a**) 126_{10} (**b**) 1111111_2 (**c**) 175_8 (**d**) 81_{16}

4. Elementary Boolean Algebra

Simplify the following expression as much as possible:

$$(\overline{A}B + AB)(\overline{AB})$$

5. Elementary Boolean Algebra

List all ordered triples that make the following expression true:

$$(\overline{AB} + C)(\overline{A} + C)(\overline{B + C})$$

1. The following table shows the values the variables take when the program is run.

J	K	A
1	1	1
1	5	6
1	9	15
4	4	31
4	8	63
7	7	112
10	10	212

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2. Work from the right to the left, carrying as needed. All numbers are in octal, except where noted.

$$\begin{aligned} 7 + 5 &= 12_{10} = 14 \\ carry + 4 + 3 &= 8_{10} = 10 \\ carry + 2 + 4 &= 7 \\ 3 + 6 &= 9_{10} = 11 \end{aligned}$$

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3. Compare the numbers by converting each of them into a common base. Since it's easy to convert among base 2, 8, and 16, the obvious approach to this problem is to choose one of those, and then convert the decimal number into that base. However, because these numbers are pretty small, converting them all into base 10 is easy. The values of the numbers are as follows:

(**b**) $1111111_2 = (10000000 - 1)_2 = (128 - 1) = 127$

(**c**) $175_8 = 1 \cdot 8^2 + 7 \cdot 8 + 5 = 64 + 56 + 5 = 125$

(**d**) $81_{16} = 8 \cdot 16 + 1 = 129$

(**d**)

4. The simplification is as follows:

$$\begin{aligned} (\overline{A}B + AB)(\overline{AB}) &= B(\overline{A} + A)(\overline{A} + \overline{B}) \\ &= B(\overline{A} + \overline{B}) \\ &= B\overline{A} + B\overline{B} \\ &= B\overline{A} \end{aligned}$$

The operands of the AND may be commuted. Thus, the following answer is also correct: $B\overline{A}$

$\overline{A}B$

5. In order for the expression to be true, each of the three factors must be true. The rightmost factor, $(\overline{B + C})$ is true only when $B = 0$ and $C = 0$. After substituting for C in the middle factor, $(\overline{A} + 0)$ is true only when $A = 0$. Fortunately, the other factor is also true when $A = 0$, $B = 0$, and $C = 0$.

$(0, 0, 0)$